M68EVB912C32

Evaluation Board for Motorola MC9S12C32

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Cautionary Notes

1) Electrostatic Discharge (ESD) prevention measures should be applied whenever handling this product. ESD damage is not a warranty repair item.

2) Axiom Manufacturing does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under patent rights or the rights of others.

3) EMC Information on the M68EVB912C32 board:

   a) This product as shipped from the factory with associated power supplies and cables, has been tested to meet with requirements of CE and the FCC as a **CLASS A** product.

   b) This product is designed and intended for use as a development platform for hardware or software in an educational or professional laboratory.

   c) In a domestic environment this product may cause radio interference in which case the user may be required to take adequate prevention measures.

   d) Attaching additional wiring to this product or modifying the products operation from the factory default as shipped may effect its performance and also cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

Terminology

This development board applies option selection jumpers. Terminology for application of the option jumpers is as follows:

> Jumper on, in, or installed = jumper is a plastic shunt that fits across 2 pins and the shunt is installed so that the 2 pins are connected with the shunt.
>
> Jumper off, out, or idle = jumper or shunt is installed so that only 1 pin holds the shunt, no 2 pins are connected, or jumper is removed. It is recommended that the jumpers be idled by installing on 1 pin so they will not be lost.

This development board applies hardwired option selections for several option jumper selections. This option selection applies a circuit trace between the option pads to complete a default connection. This type connection places an equivalent Jumper Installed type option. The circuit trace between the option pads may be cut with a razor blade or similar type knife to isolate the default connection provided. Applying the default connection again can be performed by installing the option post pins and shunt jumper, or by applying a wire between the option pads.

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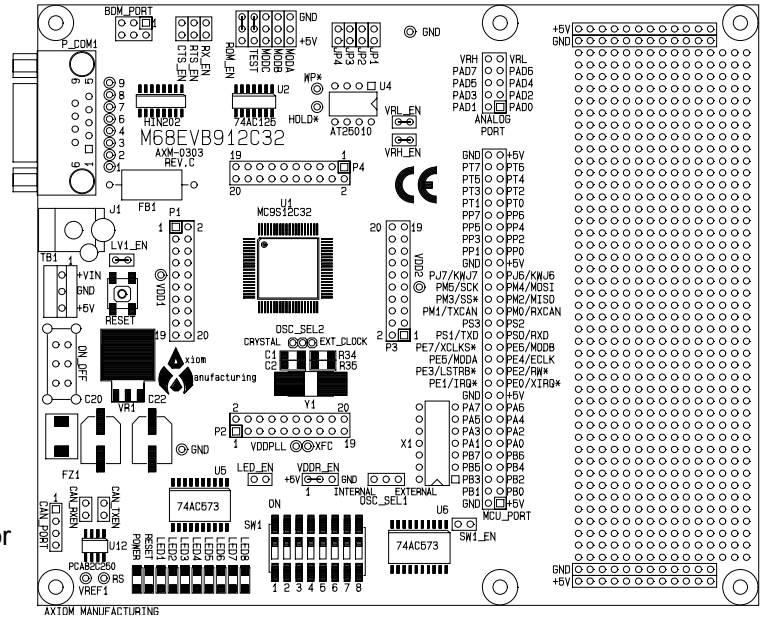
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FEATURES

The M68EVB912C32 is an evaluation or development board for the MC9S12C32 microcontroller. Development of applications is quick and easy with the included DB9 serial cable, sample software tools, examples, and debug monitor. The prototyping area provides space to apply the MCU I/O to your needs. The BDM_PORT is provided for development tool application and is compatible with HCS12 BDM interface cables and software.

Features:

- MC9S12C32 CPU
  - * 32K Byte Flash
  - * 2K Bytes Ram
  - * 61 I/O lines (80 pins)
  - * 6 PWM Timer channels
  - * 8 I/O Timer Channels
  - * 8 Channel 10 BIT A/D
  - * SPI Serial Port
  - * SCI Serial Port
  - * CAN 2.0 Port
  - * Key Wake-up Ports
  - * BDM DEBUG Port
  - * Clock generator w/ PLL
  - * Up to 25Mhz operation
- 8Mhz Clock Oscillator
- Regulated +5V power supply
- SCI1 Serial Port w/ RS232 DB9-S Connector
  - * SCI1 Serial Port
- CAN Port w/ 1M baud transceiver
- Power ON/OFF switch
- User Components Provided
  - * 8 LED Indicators (PB0-7)
  - * 8 Position DIP Switch (PA0-7)
- MCU Port connector provides all digital I/O
- Analog Port connector provides analog inputs or PAD0-7 I/O
- Large Prototype Area
- Optional SPI Serial EEPROM
- Supplied with DB9 Serial Cable, Documentation (CD), Manual, and Wall plug type power supply.



M68EVB912C32

Specifications:

Board Size 5” x 6”
Power Input: +6 to +20VDC, 9VDC typical
Current Consumption: 40ma @ 9VDC input

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GETTING STARTED

The M68EVB912C32 single board computer is a fully assembled, fully functional development board for the Motorola MC9S12C32 microcontroller. Provided with wall plug power supply, support disk, and serial cable. Support software for this development board is provided for Windows 95/98/NT/2000/XP operating systems.

Development board users should also be familiar with the hardware and software operation of the target HCS12 device, refer to the provided Motorola User Manual for the device and the HCS12 Reference Manual for details. The EVB board purpose is to promote the features of the 9S12C32 device or to assist the user in quickly developing an application with a known working environment. Users should be familiar with memory mapping, memory types, and embedded software design for the quickest successful application development.

Application development may be performed by applying the provided embedded serial interface **Debug Monitor**, or by applying a compatible HCS12 BDM cable with supporting host software. The debug monitor dedicates the SCI serial port as its connection to the host PC and does not use the traditional background debug mode, thus eliminating the necessity for a background debug mode cable.

The **Debug Monitor** in conjunction with a program running on a host personal computer (PC) provides an effective and low cost debug method. Debug monitor operation enables a user to erase device FLASH memory, program FLASH memory, load application programs, and debug the application programs. Free host software is available for execution on a PC as an interface to the monitor.

Debug monitor firmware is provided in the development board HC12 device internal flash memory and applies some HC12 resources for operation. See the Monitor commands application note from Motorola for details and the Debug Monitor chapter in this manual for more information. User applications operated under monitor control may be configured for dedicated operation by applying the User Reset Vector (0xF7FE/F) and programming the application into the device flash. The monitor will remain in protected flash memory for future use if needed.

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M68EVB912C32 STARTUP

1) Apply power to the EVB board with the provided wall-plug power supply.

2) Install the provided serial cable between the EVB board COM1 port and an available COM port on the host PC.

3) Install monitor hosting software on the host PC and launch.

4) Set the EVB board ON - OFF switch to the ON position and verify the POWER indicator is ON. The EVB is ready to use.

5) Note that if the User Reset vector is programmed, the SW1_EN option jumper must be installed and SW1 position 6 set to the ON position to enable the monitor.

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Reference Documentation

Reference documents are provided on the support CD in Acrobat Reader format.

Monitor Commands – HCS12 Serial Monitor application note.
9S12C32 manual – 9S12C32 user manuals
CPU12RM – HCS12 core user manual with instruction set
M68EVB912C32_SCH_C.pdf – M68EVB912C32 board schematics

DEBUG MONITOR OPERATION

See the Monitor commands application note on the monitor for complete details of operation. Basic operation is provided in this manual. The monitor occupies 2K bytes of flash memory and about to 50 bytes of stack space. It provides a binary command set via the HC12 SCI port and COM1 connection. Monitor operation provides a 24Mhz bus or E clock frequency by default with an 8Mhz reference frequency input.

COMMUNICATION:

The monitor provides 115.2K baud serial communication on the SCI1 interface port. Monitor applies the SCI Interrupt service in the HC12 device.

POWER ON or RESET PROMPT:

The monitor will provide a binary prompt to the EVB board serial COM1 port.

COMMANDS:

No user commands can be applied with a keyboard with software such as HyperTerminal or AxIDE. The monitor commands are binary and not compatible with keyboard (ASCII) entry or display. Host based software should interface with the monitor on the serial communication port to provide development support.

INTERRUPT SERVICE SUPPORT:

The monitor provides vector relocation in the 9S12C32 flash so user interrupt vectors appear from 0xF780 to 0xF7FF memory space. User will not have access to the SCI, SWI, and RESET vectors while the monitor is operating. Programming the user Reset vector will cause the monitor to execute the user program on Reset. Interrupt and Reset vectors are remapped from 0xFF80 – 0xFFFF to the 0xF780 – 0xF7FF memory range on a one to one basis for user application access.

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MONITOR MEMORY MAP:

0x0000 - 0x03FF	9S12C32 Register Space. See the 9S12C32 User Manual for details
0x0400 - 0x37FF	Not applied on the EVB
0x3800 - 0x3FFF	9S12C32 Ram space, user application ram Initial Monitor stack = 0x3FFF (reserve 50 bytes)
0x4000 - 0x7FFF	Not applied on the EVB
0x8000 - 0xF77F	User Application Flash Memory
0xF780 - 0xF7FF	User Interrupt Vectors
0xF800 - 0xFFFF	Monitor Flash Memory Space (**Protected**)

M68EVB912C32 Board Operation

The M68EVB912C32 board provides input and output features to assist in application development. These features may be isolated from the applied HCS12 I/O ports by the option jumpers. This allows alternate use of the HCS12 I/O ports for other application and connection on the I/O port connectors. Caution should be observed so that the HCS12 I/O port pin applied to an on board feature is not also applied to external components by the user.

POWER SUPPLY

Input power is applied by external connection to the J1 power jack or TB1 power access term block. ON_OFF switch operation will enable the +VIN power source from either connection. +VIN is polarity protected by D3 and current limited by FZ1. VR1 provides the main regulated +5V supply and VR2 provides a regulated 2.5V core interface supply applied by the X1 clock oscillator buffer circuits.

ON_OFF Switch

The ON_OFF slide switch provides board power on and off control. With the switch in the ON position +VIN is applied to the regulator circuits. With +VIN applied and ON_OFF in the ON position, the POWER indicator should be ON.

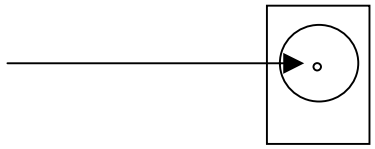
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PWR - Power Jack

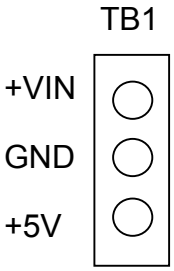
PWR provides the default external power input to the board. The PWR jack accepts a standard 2.0 ~ 2.1mm center barrel plug connector (positive voltage center) to provide the +VIN supply of +6 to +20VDC (+9VDC typical).

+Volts, 2mm center



TB1 - Power Access Term Block

TB1 provides access to either apply or tap the +VIN power source to the EVB or to tap the +5V regulated supply for external application. User may apply up to 100ma of +5V to external circuits with a 9VDC +VIN supply. +VIN supply application to user circuits is determined by the +VIN source supply rating or 1 Amp, whichever is greater.



VDDR_EN

The VDDR_EN option is hardwired by circuit trace to enable the MC9S12C32 internal 2.5V regulator. The user should not need to modify this connection.

RESET and RESET Configuration

Operation of the MC9S12C32 during RESET condition allows several options to be configured. These options include Mode of operation, memory configuration, clock source, and development mode selection. The Mode of operation including development modes is defined by the MODA, MODB, and MODC option jumpers. Memory configuration of the internal flash is provided by the ROM_EN option. Refer to the Oscillator X1 and Y1 chapter for clock source configuration.

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RESET SWITCH

RESET Switch operation will place the MC9S12C32 in the Reset state. An additional 150 millisecond delay is provided by LV1 after the switch is released. The RESET switch should not be applied with BDM cables connected to the EVB board. The BDM should control RESET generation from the connection on the BDM Port.

LV1 Reset Generator

Power up Reset is generated by the LV1 voltage detector. The detector will maintain the Reset condition whenever the +5V supply is below 4.5V. The Reset signal is delayed by 150 milliseconds from the correct voltage condition.

LV1_EN Option

The LV1_EN option is a hardwired by circuit trace enabled option. This option allows the user to isolate the LV1 reset generator and Reset switch from the Reset signal to the MC9S12C32. this option does not need modified by the typical EVB board user.

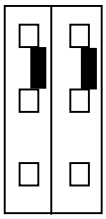
RESET Indicator

Reset indicator will light during the active low Reset signal.

MODA and MODB Options

MODA and MODB jumper options configure the MC9S12C32 in single chip, peripheral, or expanded bus operation at Reset. The M68EVB912C32 board supports the Single-chip mode by default and does not provide the necessary circuits to operate a bus. The user should not need to change the MODA and MODB option from the default positions. Refer to the MC9S12C32 user manual for additional details.

MODB MODA



GND (Logic low, **Default = Single Chip Mode**)

+5V (Logic high)

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MODC Option

MODC jumper option selects Special or Development Mode of operation when in the GND or logic low position. The MODC option jumper must be configured correctly for proper operation of the EVB board and 9S12C32. The option jumper should be in the default Normal mode position at all times unless a BDM cable is attached to the BDM PORT. When a BDM cable is attached to the BDM_PORT the MODC option must be placed in the Special Mode or GND position.

MODC



GND (Logic low, Special Modes and BDM cable is attached)

+5V (Logic high, **Default = Normal Modes**)

ROM_EN Option

ROM_EN option is a hardwired by circuit trace option that enables the MC9S12C32 internal flash in all modes. The EVB board does not provide expanded mode operation support circuits so this option should not need modified by the user.

TEST Option

The TEST option is provided for factory use and should not be modified by the user.

Oscillator X1 and Y1

The EVB provides versatile oscillator application with the Y1 crystal circuit or the X1 clock oscillator location. Option jumpers OSC_SEL and OSC_SEL2 select the oscillator source and type for the HCS12 device. The option jumpers allow both types of oscillator source to be installed on the EVB board without conflicts.

Default oscillator on the EVB is an 8Mhz clock oscillator installed in the X1 socket. The X1 socket provides for installation of standard half or full size CAN type clock oscillators that operate at 5VDC. A buffer circuit (U3) provided on the EVB limits the X1 output to 2.5Vpp for compatibility with the HCS12 EXTAL input.

Crystal location Y1 and associated components C1, C2, R34, and R35 (SMT 1206 size) provide for user application of a crystal oscillator. The user should refer to the HCS12 device user manual for information on frequency selection. The large Y1 component landing pads accommodate several types of surface mount crystal packages however, the surface mount HC49US type is most common. Loading capacitors C1 and C2 should be determined by the crystal specification. R34 provides series loading and R35 provides parallel loading with the crystal.

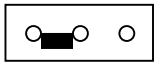
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OSC_SEL1 Option – HCS12 clock mode

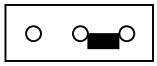
OSC_SEL1 provides HCS12 oscillator configuration during device RESET configuration. The option provides the logic value desired for the selected oscillator mode to the HCS12 PE7/XCLKS input during RESET. The OSC_SEL1 option must be configured in conjunction with the OSC_SEL2 option for correct HCS12 operation. See the Oscillator Configuration Table for details.

OSC_SEL1 – Crystal Oscillator Mode (Y1 circuit)



INTERNAL EXTERNAL

OSC_SEL1 – External Clock Mode (X1 source default)

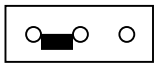


INTERNAL EXTERNAL

OSC_SEL2 Option

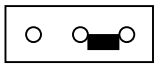
OSC_SEL2 provides HCS12 oscillator or clock input selection. The option provides the input source to the device EXTAL input pin. The OSC_SEL2 option must be configured in conjunction with the OSC_SEL1 option for correct HCS12 operation. See the Oscillator Configuration Table for details.

OSC_SEL2 – Crystal Oscillator Mode (Y1 circuit)



CRYSTAL EXT_CLOCK

OSC_SEL2 – External Clock Mode (X1 source)



CRYSTAL EXT_CLOCK

Oscillator Configuration Table

OSCILLATOR SOURCE	OSC_SEL1 Setting	OSC_SEL2 Setting
X1 clock	EXTERNAL	EXT_CLOCK
Y1 crystal	INTERNAL	CRYSTAL

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COM1 (SCI) Port

COM1 is a standard RS-232 compatible serial port controlled by the 9S12C32 SCI port. The RX_EN, CTS_EN, and RTS_EN option jumpers provide HCS12 I/O port connection to the COM1 port on the EVB board. This allows the user to apply the provided communication transceiver or to apply the associated I/O to other purposes. The option jumper positions should be reviewed first if any operational problems are encountered with the COM1 or HCS12 SCI port.

COM1 Connection

The COM1 port provides standard 9 pin connection with RS232 type interface to the HCS12 SCI peripheral. Refer to the options for enabling the HCS12 signals applied to these ports. The COM1 port is applied by default with the Debug Monitor. The HCS12 SCI module TxD and RxD signals are converted to RS232 levels by U11 and provided to the DB9 serial connectors. Following is the DB9S connection reference.

COM1

1	**1**		X	Female DB9 connector that interfaces to the HCS12
TXD	**2**	**6**	6	internal SCI serial port via the U11 RS232 transceiver.
RXD	**3**	**7**	7 CTS in	
4	**4**	**8**	8 RTS out	
GND	**5**	**9**	9	**1,4,6 connected**

Notes:

1) COM1 pins 1, 4, and 6 can be isolated from each other on the bottom of the EVB board under the COM1 connection test pads by cutting the associated test pad circuit trace.

2) COM1 pin 8 (RTS) is pulled to the active flow control enabled level when the RTS_EN option is open. (flow is enabled)

3) Test pad connections are provided for COM1 pins 1-4 and 6-9. The test pads are located behind the COM1 connector on the EVB board.

RX_EN Option

The RX_EN option jumper will isolate the HCS12 SCI RxD pin (PS0) from the RS-232 transceiver (U11). This allows the HCS12 I/O pin or Transceiver output to be applied to some other user application. Note that this option jumper must be installed for monitor communication.

RTS_EN and CTS_EN Options

These options allow the user to apply RS-232 serial flow control on the COM1 port. Note that the Monitor communication does not support the flow control operation and that if the user application has configured the RTS output disabled the monitor will not operate.

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RTS_EN

The RTS-EN option installed will connect HCS12 I/O port PJ6 (output mode) to the transceiver as the RTS flow control output signal. User application should configure PJ6 as an output and apply a logic low to enable the reception of data from the distant end (PC host normally). A logic high on PJ6 will indicate to the distant end that data should not be sent. User should not apply PJ6 on the MCU_PORT connector if the RTS_EN option is installed.

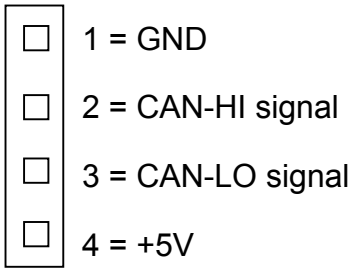
CTS_EN

The CTS-EN option installed will connect HCS12 I/O port PJ7 (input mode) to the transceiver as the CTS flow control input signal. User application should configure PJ7 as an input and test for a logic low input before transmitting serial data to the distant end (PC host normally). A logic high input on PJ7 will indicate that the distant end is not ready to receive data and no data should be transmitted. User should use caution not to apply PJ7 on the MCU_PORT connector if the CTS operation is applied or to configure PJ7 as an output with the CTS_EN option installed.

CAN Port

The CAN PORT provides a 1M baud CAN network transceiver (U12) with CAN_TXEN and CAN_RXEN options to connect the 9S12C32 CAN signals to the transceiver. Termination and bias component locations RC11, RC12, and RC13 are also provided on the CAN_PORT. The CAN_PORT is a 4 position .1 inch space header pin connector with .025sq. pins. See the MC9S12C32 User Manual for information on operating the device CAN peripheral.

CAN_PORT



CAN_TXEN and CAN_RXEN Options

The CAN_TXEN and CAN_RXEN options connect the HCS12 ports PM1/TXCAN and PM0/RXCAN respectfully to the CAN transceiver (U12). User should open these option jumpers to apply the PM0 and PM1 I/O ports on the MCU_PORT for other applications.

RS Test Pad and Cut Option 1

CAN Transceiver U12 is enabled at all times by the default connection to ground provided by Cut Option 1. The user may cut the Cut Option 1 to isolate the ground connection from the transceiver and apply an HCS12 I/O port output to the RS Test pad to control the CAN transceiver. Cut Option 1 is located on the bottom of the EVB board under the CAN_PORT. Operation of the RS Test Pad with a HCS12 port output would be logic low to enable the transceiver and logic high to disable the transceiver.

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RC11,12,and 13 CAN Terminations

RC11, RC12, and RC13 provide SMT 1206 size component locations to apply CAN network termination and bias. The values of these components should be determined by the media type and CAN network requirements.

RC12 = Termination, connected between CAN-HI and CAN-LO.

RC11 = BIAS, CAN-HI idle bias to ground potential.

RC13 = BIAS, CAN-LO idle bias to +5V potential.

LED 1-8 Indicators and LED_EN Option

LED Indicators 1–8 are provided for user application and reflect HCS12 I/O ports PTB0 – PTB7 logic value respectfully when the LED_EN option is installed. PTB0 – PTB7 are buffered from the LED indicators by U5. The LED indicators will light with a logic high signal applied from the respective HCS12 I/O port. The user may apply the PTB signals as inputs or outputs. PTB outputs will allow the user application to control LED indication with a logic high output. PTB inputs will provide a logic input status indication and should be driven from external circuits connected on the MCU_PORT.

SW1 DIP Switch and SW1_EN Option

With SW1_EN option installed the SW1 positions 1 – 8 provide input to HCS12 ports PTA0 – PTA7 respectfully. The user should apply caution that the PTA0-7 ports are configured to be inputs at all times when the SW1_EN option is installed. The SW1 positions provide a logic low input when in the OFF position and a logic high input when in the ON position. SW1 position 6 also provides the EVB Monitor selection during Reset or power on condition. (Refer to M68EVB912C32 STARTUP).

Optional Serial EEPROM

The U4 socket and JP1-4 Options provide for the optional installation and connection of an industry standard SPI type Serial EEPROM device. The standard device referred to for installation in the EVB is the ATMEL AT25010 or larger capacity device. The JP1-4 option s will complete the HCS12 SPI port to EEPROM connections if installed. Refer to the M68EVB912C32 schematic drawing for more detail.

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M68EVB912C32 I/O PORT CONNECTORS

ANALOG and PAD0-7 I/O Port Connector

This port connector provides access to the PAD I/O or Analog input signals.

VRL	**10**	**9**	VRH
PAD7/AN7/ETRIG	**8**	**7**	PAD6/AN6
PAD5/AN5	**6**	**5**	PAD4/AN4
PAD3/AN3	**4**	**3**	PAD2/AN2
PAD1/AN1	**2**	**1**	PAD0/AN0

VRH_EN and VRL_EN Options

These options are hard wired by circuit trace on the EVB board to default potentials. The user may isolate the default connections by cutting the circuit trace between the option pads on the top of the EVB board. Application of alternate potentials can then be applied at the Analog Port location for the respective signal.

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MCU I/O Port Connector

This port connector provides access to all the MC9S12C32 I/O ports except PAD analog port. The signals in brackets are EVB alternate application signals.

GND	**60**	**59**	+5V
PT7	**58**	**57**	PT6
PT5	**56**	**55**	PT4
PT3	**54**	**53**	PT2
PT1	**52**	**51**	PT0
PP7	**50**	**49**	PP6
PP5	**48**	**47**	PP4
PP3	**46**	**45**	PP2
PP1	**44**	**43**	PP0
GND	**42**	**41**	+5V
(CTS) PJ7/KWJ7	**40**	**39**	PJ6/KWJ6 (RTS)
PM5/SCK	**38**	**37**	PM4/MOSI
PM3/SS*	**36**	**35**	PM2/MISO
PM1/TXCAN	**34**	**33**	PM0/RXCAN
PS3	**32**	**31**	PS2
PS1/TXD	**30**	**29**	PS0/RXD
PE7/XCLKS*	**28**	**27**	PE6/MODB
PE5/MODA	**26**	**25**	PE4/ECLK
PE3/LSTRB*	**24**	**23**	PE2/RW*
PE1/IRQ*	**22**	**21**	PE0/ XIRQ*
GND	**20**	**19**	+5V
(SW1-8) PA7	**18**	**17**	PA6 (SW1-7)
(SW1-6) PA5	**16**	**15**	PA4 (SW1-5)
(SW1-4) PA3	**14**	**13**	PA2 (SW1-3)
(SW1-2) PA1	**12**	**11**	PA0 (SW1-1)
(LED8) PB7	**10**	**9**	PB6 (LED7)
(LED6) PB5	**8**	**7**	PB4 (LED5)
(LED4) PB3	**6**	**5**	PB2 (LED3)
(LED2) PB1	**4**	**3**	PB0 (LED1)
GND	**2**	**1**	+5V

BDM PORT

The BDM port is a 6 pin header compatible with a Motorola Background Debug Mode (BDM) Pod. This allows the connection of a background debugger for software development, programming and debugging in real-time without using HCS12 I/O resources. Note that the MODC option jumper must be correctly configured to apply a BDM cable.

BGND	**1**	**2**	GND
	3	**4**	RESET*
	5	**6**	+5V

See the HCS12 User Manual for complete documentation of the BDM.

Freescale Semiconductor, Inc.

For More Information On This Product,
Go to: www.freescale.com